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ABSTRACT

This paper presents a study of eidetic imagery in children. An eidetic image refers to an afterimage which is both more vivid and longer lasting than other afterimages. The study attempts to analyze eidetic imagery as a psychometric problem and to relate it to other conceptually similar cognitive abilities. Two hundred forty-two second and third grade children were tested with a battery of eidetic imagery tests together with a series of verbal, figural or spatial, and imagery ability tests. Three scoring procedures were used in analyzing the eidetic imagery data. All three were utilized in correlational and factor analyses in order to arrive to the most meaningful interpretation of the structure of the eidetic imagery tests. Results of the factor analyses indicated the presence of two factors, a non memory factor representing eidetic imagery as a subjective phenomenon and a memory or recall factor. A factor analysis of the other tests used in the study yielded three factors: (1) a spatial factor, (2) a vividness of imagery factor and (3) a verbal ability factor. A further factor analysis was performed on the combined eidetic and cognitive ability tests. Four factors emerged, consisting of an eidetic imagery factor as well as the three factors defined above. Results are discussed in terms of the identification of eidetic imagery as an isolated phenomenon which appears to be unrelated to other conceptually similar cognitive abilities. (BD)

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EIDETIC IMAGERY AND FIGURAL ABILITIES IN CHILDREN

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This research attempted to place the concept of eidetic imagery in the context of psychometric testing and cognitive abilities. Despite the large number of studies on eidetic imagery, there has apparently been no comprehensive attempt to analyze eidetic imagery as a psychometric problem nor to relate it to other cognitive abilities to which it should be conceptually relevant. Rather than treating eidetic imagery first of all as a measurement problem, most studies of the phenomenon have assumed that the testing procedure identifies individuals with an unusual cognitive ability and then have proceeded to look for correlates that might provide the basis for a theoretical explanation of the phenomenon. The work of Haber and his associates in the 1960s was an exception in the sense that they introduced a relatively standardized testing procedure and provided information on its reliability and on the usefulness of the various criteria that were incorporated into the procedure. They were aware that further evaluation was essential but did not themselves take the necessary steps. It is routine in psychometric testing, for example, to analyze the factor structure of the test items themselves and to determine how the test correlates with other tests to which it may or may not be conceptually related.

The present study was an initial attempt at such a psychometric evaluation. Specifically, we tested a large number of elementary school children with an eidetic imagery test battery together with a series of verbal ability and figural or imagery ability tests. We factor analyzed

the items of the eidetic imagery test to determine if it was a unidimensional trait, as many users of the test have implicitly assumed. In addition, we performed a factor analysis on all of the tests.

METHOD

The tests were given to 242 children from grades 2 and 3 in a number of schools in London, Ontario. The tests were administered to the children in a quiet room provided by the school. Each child was first tested for color blindness and was then given the eidetic imagery test battery that was originally used by Haber and Haber (1964). The first phase of the testing involved familiarizing the child with the idea of projected images by having him stare at colored squares and asking whether they could identify the resulting negative afterimages. Following this, the child was given the eidetic imagery test which consisted of presentation of 4 picture slides, two of which are colored and two are black silhouettes. The pictures were the ones originally used by Haber and Haber (1964). The pictures are shown in the following slides. The instructions asked the child to move his or her eyes over the whole picture. After a 30-second exposure period, the slide was removed and the child was asked a series of questions about the picture. The child's responses to the questions were designed to meet 8 criteria that constituted the operational definition of eidetic imagery. The eight criteria were as follows:

1. Image: this criterion was fulfilled if the child reported "seeing" an image when asked what he or she sees on the screen after the picture was removed.
2. Projection: the child reports that the image is "out there," on the screen.
3. Positive Afterimages: this is with reference to the 2 colored pictures. The child is asked about the colors of

things appearing in the pictures. For example, with respect to the picture of the Indian brave in a canoe together with a squirrel and some fish, the child is asked about the color of the boat and of the round circle on the boat. The criterion was fulfilled if the child correctly answered at least one of the two questions.

4. Present Tense: the criterion is fulfilled if the child uses the present tense in describing the details of his or her image.
5. Scanning: "Appropriate" eye movements, that is, continuous scanning of the screen during the questioning, according to the judgment of the Experimenter.
6. Correct Pointing: This involved accurate pointing by the child to the section of the black screen where a person or object had been located. With respect to Picture slide 1, for example, the child is asked to point to where the bird, dog, man, and boy had been. The criterion was considered fulfilled if the child pointed to the correct region of the screen for at least two of the 4 items.
7. Duration: persistence of the image for at least 40 seconds.
8. Detailed Questions: This involved a series of questions concerning the content of each picture. For example, the questions for Picture slide 1 were: What animals did you see? What was the boy doing? What people did you see? Was the ground straight or crooked? Fulfillment of the criterion involved correctly answering at least two of the 4 questions.

Note that three of the criteria essentially involved cued recall: Positive Afterimages is simply an inference from the fact that the subject correctly reports the color of the pictured object as named by the Experimenter. Correct Pointing requires that the spatial location be correctly identified, again in response to the Experimenter's verbal cue. And Detailed Questions similarly refers to the recall of objects and inferred actions of pictured objects, as named by the Experimenter. With the exception of eye movements, which are based on the Experimenter's observations of the child, the remaining items involve the child's responses to questions concerning his subjective states.

Spatial ability was tested by four paper and pencil tests. These were the Flags Test of Spatial Thinking, 15 items from the Minnesota Paper Form Board (Form AA), the Kuhlman-Finch Space Test, and the Primary Mental Abilities Space Test. All of these involve what Guilford has called figural transformational ability, that is, they require mental manipulation of spatial information. For example, each item of the Flags Test involves a drawing of a flag-like pattern on the left followed by a series of 6 flags to the right, each of the six being rotated in some degree and showing either the "opposite" side of the flag (i.e., a mirror image of the target flag on the left) or the same side as the target flag. The subject's task is to indicate for each of the six choices whether it shows the same side or the opposite side as the single flag at the left. The task presumably requires the subject to rotate the flags mentally to a common orientation. Another imagery test was the Betts Questionnaire on Imagery. This was introduced because, like the spatial ability tests and the eidetic battery, it purports to measure some aspect of imagery. Moreover, like most of the eidetic imagery tests, it is a subjective test. Specifically, subjects are asked to think about a series of items such as a strawberry ice cream cone, the

exact shape of the face of their mother or some other familiar individual, and so on. They indicate the clarity of their visual imagery for each item on a 3-point scale in which the choices are Clear, Fuzzy, and None. Another subset of items similarly inquires about auditory imagery in thinking.

The verbal ability tests consisted of the Auditory Association Test of the Illinois Test of Psycholinguistic Abilities (ITPA) and the Kuhlman-Finch Verbal Subtest. In the Auditory Association Test, the child is read a series of incomplete verbal analogies and the subject is required to complete each item orally. The following is a demonstration item: A daddy is big; a baby is - . Correct answers would be little, small, tiny. The Kuhlman-Finch Verbal Subtest is a Word Grouping Test in which each item consists of a series of 5 words, one of which is different from the others in some way. A sample item, for example, consists of the words boy, man, woman, girl, and horse. The last of these is the correct "odd" item. These verbal tests were included because, unlike the imagery tests, they appear to be conceptually unrelated to eidetic imagery.

An additional reason for collecting the particular psychometric measures I have listed is that most were among the ones used by Forisha (1975) in a developmental study of mental imagery and verbal processes. We wanted to establish some contact with that literature as well as with the eidetic imagery work, particularly because of our own interest in a dual-coding approach to memory and cognition.

RESULTS

Eidetic Imagery Test Results

The eidetic imagery test was scored in several ways. First, it was scored according to the categorical procedure used by previous investigators (e.g., Doob, 1966; Haber & Haber, 1964). Thus a child was

classified as having "all eidetic imagery" if he met all of the criteria outlined above for each of the four slides. They were classified as being "mostly eidetic" or as having "some eidetic imagery" if they met lesser numbers of the criteria. Finally, they were classified as not having any eidetic imagery if no more than one slide elicited reports of a projected image and met other criteria. We found 21 children who met the criterion of having at least some eidetic imagery. This represents 8.6% of the total sample, which is comparable to previous studies by Cohen and other North American researchers. Another experimenter re-tested 18 of the eidetic children together with a matched sample of 18 non-eidetikers. Fourteen of the eidetic children re-tested as having some eidetic imagery whereas all of the non-eidetic group re-tested non-eidetic. Thus there was 88.4% agreement in the categorization of the total sample. This indicates satisfactory reliability of the eidetic test, particularly since the figure reflects both inter-judge and test-re-test reliabilities.

A second scoring procedure involved assigning a score of 1 point for a satisfactory response to each of the criterion items for each of the pictures, for a possible total quantitative score of 30 points. A third procedure involved a larger range of possible scores for items for which more than a dichotomous score was available (for example, the memory items), permitting analysis of the individual test items.

The various scoring procedures were subjected to different correlational and factor analyses in order to arrive at the most parsimonious and meaningful interpretation of the structure of the eidetic imagery test items. The simplest varimax rotated factor structure resulted from an analysis of the item scores summed over the four stimulus pictures. Most of the variance was accounted for by two factors, for which the loadings are shown in the next slide. Factor 1, which accounted for 81% of the

variance, loaded highly on all of the non-memory items of the test, namely reported imagery, projection, scanning, use of the present tense, and fulfillment of the duration criterion. Thus Factor 1 most clearly represents eidetic imagery as a subjective phenomenon. Factor 2 is clearly a recall memory factor, with moderate loadings on the questions pertaining to recall of detail and of item color. Thus the analysis separated the subjective component and the objective memory component of the eidetic test. The same general conclusion is supported by analyses in which the responses to the four stimulus pictures were kept separate. The difference was that the subjective and memory factors just described tended to separate into further picture-specific factors. For example, a 3-factor solution produced the pattern shown in the next slide. Factor 1 is again eidetic imagery, as defined particularly by responses to pictures 2, 3, and 4. Factor 2 is largely defined by the same items for stimulus Picture 1 as well as the Duration variable for each stimulus picture. Factor 3 is again a memory factor. Extraction and rotation of more factors simply generated further picture-specific factors. These complexities do not appear to have any particular theoretical significance in the present context and I won't burden you with the details. The important general point is that in all of the analyses the subjective eidetic imagery items tended to hang together and that these were always clearly separate from the recall tests.

Factor Structure of the Ability Tests

The factor analysis of the psychometric tests yielded three easily-interpretable factors. Factor 1 was clearly a spatial factor, with substantial loadings on each of the 4 figural ability tests; the second was defined by the two subtests of the Betts Questionnaire on Mental Imagery; and the third was defined by the two verbal tests. The results

are consistent with those previously obtained by us and by others in that imagery tests have tended to fall under two factors, one defined by objective figural or spatial ability tests, and the other by subjective questionnaire or self-rating tests. Additionally, verbal ability tests have usually fallen into one or more distinct factors. These factors also appear in the following analyses, which included the eidetic imagery tests as well.

Factor Structure Of the Eidetic Imagery and Ability Tests

The combined analysis of eidetic imagery along with the ability test scores was based on 219 children for whom complete data were available. Various factor analyses were again performed in order to provide the clearest and simplest interpretation of the factor structure. One analysis simply treated eidetic imagery in the traditional way as a categorical variable, as well as in terms of a quantitative eidetic imagery score based on all 30 items of the test battery. Thus the subjective and memory items were not distinguished in the analysis. The other variables were the psychometric ability tests and the two components of the Betts Questionnaire. Four factors accounted for more than 70% of the total variance. The varimax rotated factor structure, presented in the next slide, is clearly interpretable. Factor 1 is obviously eidetic imagery, with high loadings from the categorical as well as the quantitative variable. Factor 2 is clearly defined by the spatial tests. Factor 3 has high loadings only on the two Betts Questionnaire variables. And factor 4 is obviously a verbal factor, defined by moderate loadings on Word Grouping and Auditory Association. Thus eidetic imagery, defined in the traditional way as a global variable, is unrelated to spatial abilities, verbal abilities, and a questionnaire measure of vividness of imagery. The same conclusion emerged from other analyses based on a breakdown of the eidetic

imagery tests into their components. The next slide shows the results when the item scores were collapsed over the four stimulus pictures. The results revealed a separation of the eidetic test battery into subjective and memory subcomponents, shown in the slide as Factors 1 and 3. Moreover, both factors are independent of the other psychometric tests, which in turn cluster into relatively distinct spatial, image vividness, and verbal factors (Factors 2, 4, and 5, respectively). One specific exception to the last generalization is that ITPA verbal test (that is, Auditory Association) shows a moderate loading on the spatial factor, although its primary loading was on a verbal factor when the eidetic imagery items were not included in the analysis. The exception isn't pertinent to the main point of the study and I won't pursue it here. Further analyses involving the eidetic imagery items separated by slide confirmed the independence of the components I have already described, and again revealed further picture-specific factors. They also indicated weak positive relations between the Kuhlman-Finch Verbal Subtest (Word Grouping) and some of the eidetic imagery test items. Examination of the correlation matrix shows that only five items correlate .20 or higher with the verbal test, the highest correlation being .31. This involved the location memory item for stimulus Picture 3. The other four items were the detailed recall items for stimulus Pictures 1 and 3, and the present tense and duration variables for Picture 1.

DISCUSSION

Several conclusions are justified by the analyses. First, the eidetic imagery test battery separates into at least two relatively independent factors. One involves the subjective report and other non-memory criteria. Specifically, the child reports an image, agrees that it is projected "out there," shows scanning eye movements, and meets a duration criterion. This factor may be regarded as corresponding to eidetic imagery as traditionally

defined. The other component is defined by the memory items, particularly recall of color and other details from the slides. A second important conclusion is that the eidetic test is quite independent of spatial abilities, subjective imagery as defined by the Betts Questionnaire, and generally independent of verbal ability. The last point is qualified slightly by small correlations between one of the verbal tests and a few of the eidetic imagery test items. More generally, eidetic imagery, memory, spatial ability, verbal ability, and the Betts Imagery Tests are all relatively independent from each other.

These findings extend the gloomy generalization that emerges from the previous literature. The reviews by Leask, Haber, and Haber (1969) and by Gray and Gummerman (1975) indicate that eidetic imagery is generally unrelated to other variables, including memory ability itself. The present research confirms and extends the generalization to include a set of standardized psychometric tests. The absence of any consistent relation to memory is particularly important because eidetic imagery was originally identified with the concept of "photographic memory," which implies that the eidetic child should show unusually accurate recall. This does not seem to be the case within the context of the eidetic test battery itself. Nor is it the case when eidetic and non-eidetic children are compared on an independent memory test? More than a year ago, Cohen and I conducted a study in which 14 eidetic children and 14 controls, matched for age and other criteria, were given a recognition memory test for pictures. The experiment involved children who had been previously tested for eidetic imagery in connection with Cohen's Masters thesis study. We were interested in determining whether the two groups would differ in their recognition memory for a series of pictures when the results are subjected to a signal detection analysis. I won't go into the details of the study here. Suffice

to say that we found no significant difference between the two groups of children on any measure. The eidetic children were neither more accurate nor more confident in their recognition performance than the non-eidetic group.

Thus eidetic imagery remains an isolated curiosity. It is not only a cross-cultural "will-o'-the-wisp," as Doob called it, but a within-culture will-o'-the-wisp as well. This leaves me wondering whether eidetic imagery is a variable of any theoretical interest to psychologists. I have always tended to be skeptical of the phenomenon and my skepticism has only been increased by the results reported here. Nonetheless, I'm sure that the concept will continue to tantalize imagery researchers. The fascination is reinforced partly by the fact that those who have been involved directly in testing eidetic individuals have the subjective impression that such people differ in some fundamental way from their non-eidetic counterparts. Given such impressions, it is always tempting to say that previous researchers simply have not looked at the right variables. In regard to our own research, for example, it could be argued that we did not choose the relevant ability tests. The spatial tests measure the child's ability to manipulate spatial information mentally. The eidetic imagery test situation does not require such transformations. Thus it could be argued that the spatial abilities were simply inappropriate for testing the special skill of the eidetiker. However, Leask, Haber, and Haber report instances of high eidetic children who showed remarkable ability to manipulate their images. Gummerman and Gray summarize other similar evidence as well. Thus it cannot be definitively concluded that our tests were irrelevant. On both conceptual and empirical grounds, there ought to have been some relationship between eidetic scores and spatial abilities. The same argument can be made for the Betts Vividness

Questionnaire. Since no such relationships appeared, it seems that eidetic imagery is unrelated ever to other imagery tests. This conclusion is contrary to one suggested by Gray and Gummerman in their review. They asserted their belief that "the distinction often made between eidetic imagery and visual memory imagery is not valid (1975, p. 404)." In fact, the present study indicates that the distinction is quite valid in that eidetic imagery is unrelated to other tests of imagery as well as memory. Moreover, whereas imagery as a memory ability is now reasonably well understood and shows relationships to a variety of other variables, eidetic imagery does not. Until such relationships are demonstrated, if they ever are, we should hesitate to talk about eidetic imagery as though it were a well-established and interesting psychological phenomenon.

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Varimax Rotated Factor Matrix, after Rotation with Kaiser Normalization, of Eidetic Imagery Test Items, Collapsed over Stimulus Pictures

	FACTOR 1	FACTOR 2
Image	.935	.140
Projection	.845	.177
Color Recall	.175	.662
Detail Recall	.047	.764
Scanning	.878	.141
Present Tense	.878	.136
Location Recall	.035	.183
Duration	.854	.133

Varimax Rotated Factor Matrix of Eidetic Imagery

Test Items over Four Stimulus Pictures

		FACTOR 1	FACTOR 2	FACTOR 3
EI_1 -	Image	✓.36212	✓.69404	.03910
	Projection	.23089	✓.80620	.02187
	Detail Recall	-.02728	.08545	.33344
	Scanning	.27046	✓.45940	.02001
	Present Tense	.30123	✓.61615	-.03665
	Location recall	.04953	-.01436	.18273
	Duration	.25169	-.78622	-.02152
EI_2 -	Image	✓.75620	.28671	.17111
	Projection	✓.80474	.28975	.15631
	Color recall	.05916	.05151	✓.49325
	Detail recall	.03685	.08860	✓.59514
	Scanning	✓.72192	.28546	.16440
	Present Tense	✓.70882	.32384	.10189
	Location Recall	.01211	-.08454	.16216
	Duration	✓.64275	✓.48352	.13392
EI_3 -	Image	✓.81037	.15449	.11753
	Projection	✓.74377	.22471	.17510
	Detail Recall	.07157	.01172	.17998
	Scanning	✓.70522	.12489	.18149
	Present Tense	✓.37585	.18347	.14478
	Location Recall	.02014	-.06040	.11774
	Duration	✓.61530	✓.45098	.16495
EI_4 -	Image	.84504	.10180	.02319
	Projection	.86533	.08249	.02002
	Color Recall	.02911	.06842	✓.58511
	Detail Recall	.00577	.16896	✓.63276
	Scanning	✓.83670	.07927	.03061
	Present Tense	✓.78375	.10060	-.03137
	Location Recall	.09979	-.03753	.22908
	Duration	-.77652	.34222	.11051

Varimax Rotated Factor Matrix of Psychometric Tests and Eidetic Imagery Categorical and Quantitative Scores Collapsed over all Stimulus Pictures

	Factor 1	Factor 2	Factor 3	Factor 4
MPFB	.015	.588	.074	.165
K-F Space	.090	.676	.009	.063
PMA Spatial	-.067	.714	-.103	.165
Flags	.015	.551	-.128	.263
K-F Verbal	.004	.171	.086	.629
ITPA-Aud. Assoc.	.241	.259	.017	.530
EI-Quantitative	.919	.032	.015	.217
EI-Categorical	.929	.019	.067	.029
Betts 1	.085	-.073	.711	-.024
Betts 2	-.020	.005	.733	.121

Varimax Rotated Factor Matrix, after Rotation with Kaiser Normalization, of Psychometric Tests and Eidetic Imagery Tests Collapsed over Stimulus Pictures

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
MPFB	.006	.613	-.014	.068	.068
K-F Space	-.002	.689	.036	.046	-.063
PMA Spatial	-.149	.752	.049	-.077	.031
Flags	.040	.567	-.039	-.129	.298
K-F Verbal	.078	.184	.189	.018	.483
ITPA-Aud. Assoc.	.004	.449	.153	.116	.084
Image	.939	.069	.097	.059	-.127
Projection	.945	.092	.105	.014	-.008
Color Recall	.092	.069	.656	.013	-.001
Detail Recall	.164	.002	.753	-.031	.191
Scanning	.890	-.013	.098	-.059	.036
Present Tense	.903	-.123	.067	-.011	.111
Location Recall	.058	.207	.218	-.100	.144
Duration	.819	-.109	.112	.053	.218
Betts 1	.084	-.020	-.089	.730	-.046
Betts 2	-.050	.075	.040	.738	.036